

What is claimed is:

1. A device for sorting particles, comprising:
a channel structure defining a channel having an inlet and first and second outlets;
5 a first transport mechanism configured to create a particle stream of first particles and one or more second particles, each particle traveling along the channel from the inlet toward the first outlet and disposed in a fluid supported by the channel structure; and
a second transport mechanism configured to be pulse-activated to
10 selectively move at least one of the second particles from the particle stream and toward the second outlet.
2. The device of claim 1, wherein the channel structure includes a substrate and a plurality of thin-film electrical devices formed on the substrate,
15 and wherein the second transport mechanism is included in the thin-film electrical devices.
3. The device of claim 2, wherein the channel structure includes a fluid barrier connected to the substrate so that the thin-film electrical devices are
20 disposed between the substrate and the fluid barrier.
4. The device of claim 1, wherein the first transport mechanism is configured to create a flow of the fluid through the channel, and wherein the flow of the fluid creates the particle stream.
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5. The device of claim 4, wherein the first transport mechanism is configured to produce a pressure drop along the channel.
6. The device of claim 1, wherein the channel structure is configured
30 so that the particle stream follows a path from the inlet to the first outlet without operation of the second transport mechanism, and wherein the second transport mechanism is configured to exert pressure pulses directed transverse to the path.

7. The device of claim 6, wherein one of the pressure pulses is configured to move a fraction of the fluid from the path, the fraction including the at least one second particle.

5 8. The device of claim 1, wherein the second transport mechanism includes at least one of a heater element and a piezoelectric element.

9. The device of claim 1, wherein the channel is a first channel and the inlet is a first inlet, the channel structure defining a second channel adjacent to
10 the first channel and configured to carry another fluid from a second inlet to a third outlet, and wherein the second outlet of the first channel places the first channel in fluid communication with the second channel.

10. The device of claim 1, wherein the channel structure defines a
15 passage disposed in fluid communication with the channel and generally opposing the second outlet, and wherein the passage includes a fluid diode configured to restrict fluid backflow created by operation of the second transport mechanism.

20 11. The device of claim 1, further comprising an optical sensor configured to sense the at least one second particle in the particle stream, the optical sensor being coupled to the second transport mechanism so that sensing the at least one second particle actuates the second transport mechanism.

12. A device for sorting particles, comprising:
a channel structure defining a channel having an inlet and first and second outlets;

a first transport mechanism configured to move first particles and one or more second particles in the channel from the inlet toward the first outlet, the first particles and one or more second particles being disposed in a fluid; and

a second transport mechanism configured to apply a transient pressure pulse on the fluid so that at least one of the second particles is selectively moved toward the second outlet.

13. The device of claim 12, wherein the second transport mechanism includes at least one of a heater element and a piezoelectric element.

14. The device of claim 12, wherein the first transport mechanism is configured to create a flow of the fluid through the channel, and wherein the flow of the fluid carries the first particles and one or more second particles.

15. The device of claim 14, wherein the second transport mechanism is configured to apply the transient pressure pulse to a segment of the fluid in which the at least one second particle is disposed.

16. The device of claim 12, wherein the channel structure is configured so that the first particles and one or more second particles follow a path from the inlet to the first outlet without operation of the second transport mechanism, and wherein the transient pressure pulse is directed transverse to the path.

17. A device for sorting particles, comprising:
a channel structure defining first and second channels in fluid communication;
a first transport mechanism configured to send respective first and second
5 streams through the first and second channels, the first stream including first particles and one or more second particles; and
a second transport mechanism configured to selectively move at least one of the second particles from the first stream to the second stream.

10 18. The device of claim 17, wherein the channel structure includes a substrate and a plurality of thin-film electrical devices formed on the substrate.

19. The device of claim 17, wherein the first particles and the one or more second particles are different types of cells.

15 20. The device of claim 17, wherein the first stream follows a path, and wherein the second transport mechanism is configured to apply transient pressure pulses to the first stream and transverse to the path.

20 21. A device for sorting particles, comprising:
a substrate assembly including a substrate and a fluid barrier connected to the substrate, the substrate assembly defining a channel having an inlet and first and second outlets;
a transport mechanism configured to create a particle stream of first
25 particles and one or more second particles, each particle traveling along a path in the channel from the inlet toward the first outlet; and
a thin-film electrical device formed on the substrate and configured to be pulse-activated to selectively move at least one of the second particles from the particle stream and toward the second outlet.

22. The device of claim 21, wherein the transport mechanism is configured to apply at least one of a positive and a negative pressure to a fluid in which the first particles and one or more second particles are disposed.

5 23. The device of claim 22, wherein the transport mechanism operates to create the particle stream by dielectrophoresis.

24. The device of claim 21, wherein the substrate is formed at least substantially of silicon or glass.

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25. The device of claim 21, wherein the thin-film electrical device is one of a heater element and a piezoelectric element.

15 26. The device of claim 21, further comprising an optical sensor disposed adjacent or in the substrate and configured to sense a position of the one or more second particles within the channel.

20 27. The device of claim 26, wherein the optical sensor is configured to so that an actuation signal for the thin-film electrical device is produced based on the position.

28. The device of claim 21, wherein the first particles and the one or more second particles are different types of cells.

25 29. A method of sorting particles, comprising:
creating a stream of first particles and one or more second particles disposed in a supported fluid; and
selectively displacing at least one of the second particles from the stream by exerting a transient force on a portion of the stream.

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30. The method of claim 29, wherein exerting a transient force includes applying a pressure pulse on a segment of the fluid.

5 31. The method of claim 29, wherein creating a stream includes applying a substantially continuous force on the fluid.

32. The method of claim 29, wherein creating a stream includes selectively exerting a force on the first particles and one or more second particles relative to the fluid.

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33. The method of claim 29, which further comprises sensing a position of the one or more second particles within the stream, selectively displacing being initiated at a time based on the position sensed.

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34. The method of claim 29, wherein selectively displacing includes actuating one of a heater element and a piezoelectric element.

35. A method of sorting particles, comprising:
creating adjacent first and second streams, the first stream including first
20 particles and one or more second particles; and
applying a transient pressure pulse to a portion of the first stream to selectively move at least one of the second particles from the first stream to the second stream.

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36. The method of claim 35, wherein the first stream includes a fluid in which the first particles and one or more second particles are disposed, and wherein creating includes exerting a pressure on the fluid so that the fluid and the first and second particles move together.

37. The method of claim 35, wherein applying a transient pressure pulse includes actuating one of a heater element and a piezoelectric element.

38. The method of claim 35, wherein the second stream is formed at least substantially by a fluid, and wherein creating the second stream includes exerting a pressure on the fluid.

39. A microfluidic device for sorting particles, comprising:
means for creating a stream of first particles and one or more second particles disposed in a supported fluid; and
means for selectively displacing at least one of the second particles from the stream by exerting a transient force on a portion of the stream.

40. A program storage device readable by a processor, tangibly embodying a program of instructions executable by the processor to perform methods steps for sorting particles, the method steps comprising:
creating a stream of first particles and one or more second particles disposed in a supported fluid; and
selectively displacing at least one of the second particles from the stream by exerting a transient force on a portion of the stream.